

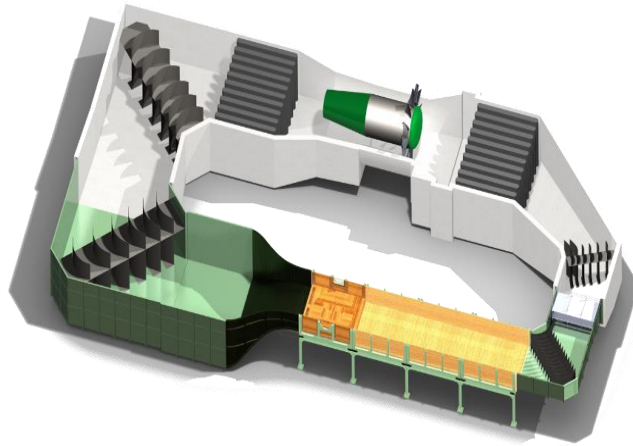
## Factsheet Kleinwindanlagen

In the course of our research projects with the Fraunhofer Institute and the BTU Cottbus, we as a group of companies have developed strongly in the field of renewable energies. The vision behind this is to make the triad between photovoltaics, wind energy and hydrogen attractive for end users and tradesmen in our region in the course of decentralizing the energy supply. One project in particular stands out in the field of horizontal small wind turbines.

These turbines are 10 meters high at the blade tip (thus permit-free) and have a diameter of 3m (1.5 m per blade). In cooperation with the Fraunhofer Institute and the BTU Cottbus, we have developed a special twist of the wing. In addition, our wings are 45% larger than those of our competitors and at the same time 35% lighter. This means that our wheel works particularly well in light wind regions, such as Brandenburg. We have already tested the efficiency of the wheels in practice and in the wind tunnel of the TU Berlin. This resulted in an efficiency level (kinetic energy of the wind into electrical energy) of 36% at 5 m/s (18 km/h; average speed in Brandenburg) and at 9.5 m/s (34.3 km/h) of 53%. These are values that you will not find elsewhere in the small wind turbine sector. The wheels are scalable in size.

### Wind tunnel test at TU Berlin (GroWiKa)

- Ring tunnel with closed sections
- Measuring chamber areas:  
Small area: 2 x 1.4 x 10 m  
Large area: 4.2 x 4.2 x 10 m
- Max. Wind speeds: 70 m/s (small area), 11m/s (large area)
- Turbine power: 450 kW



### Test setup for the investigations

- Investigation of the behavior up to a wind speed of 10 m/s
- Recording of the performance data
- Optimization of the start-up behavior in the range up to 5 m/s
- Tuning of the rotors and inverter as well as the electrical system

### Results

- Starting speed: 2.7 m/s
  - Faster start-up due to optimal rotor design taking into account aerodynamics and max. lightweight construction
  - Max. Revolutions: 450 rpm
  - Max. Efficiency: 53% at 9.5 m/s
  - 2000 W at 10.0 m/s
- 83% better performance (on average) compared to competitors on the market.



Power curve and efficiency level at wind speeds of 0 m/s - 10 m/s.

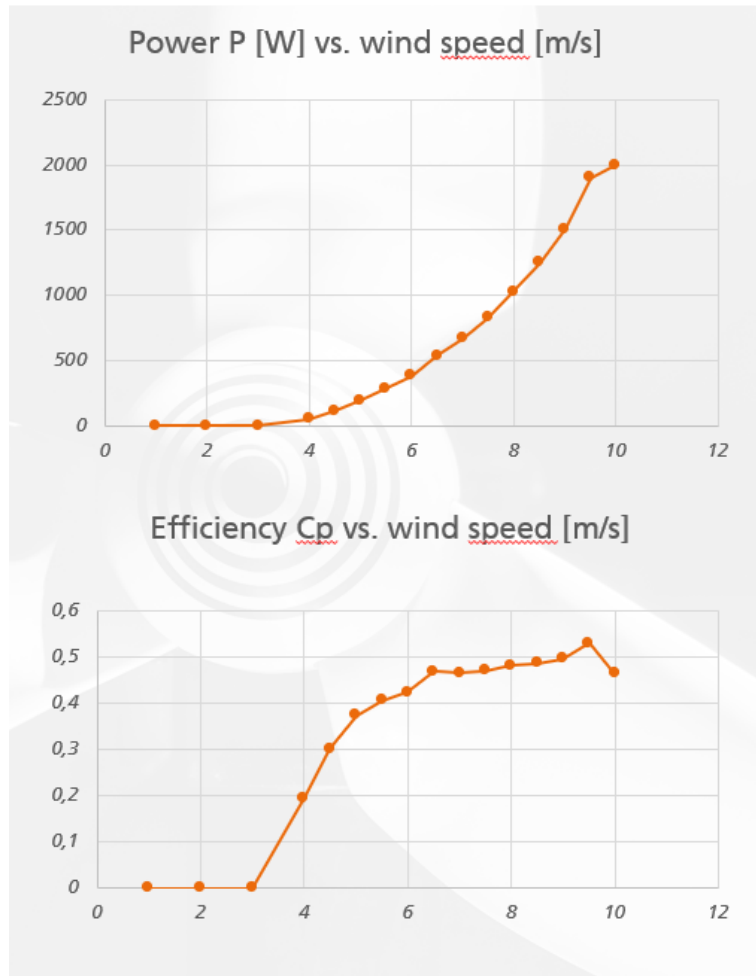
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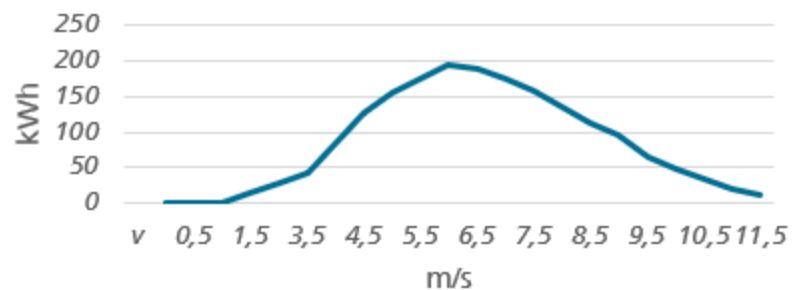
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**Evaluation of the results via Rayleigh distribution for wind distribution p.a.**

Yield WKA at 4 m/s  
average speed

Ertrag WKA bei 4 m/s  
Durchschnittsgeschwindigkeit



— Ertrag WKA in kWh

Total: 1.867,30 kWh/a

**Phoxi Energy GmbH**

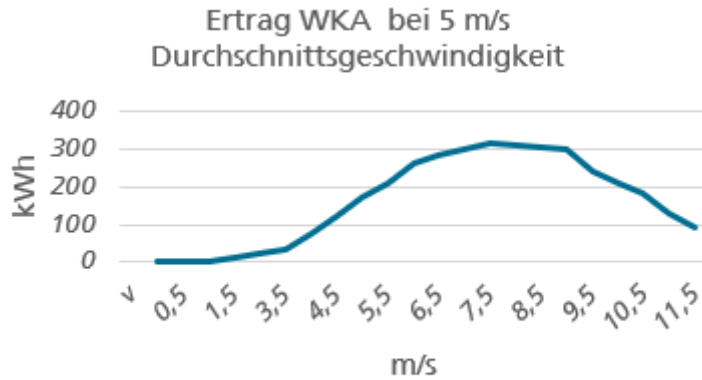
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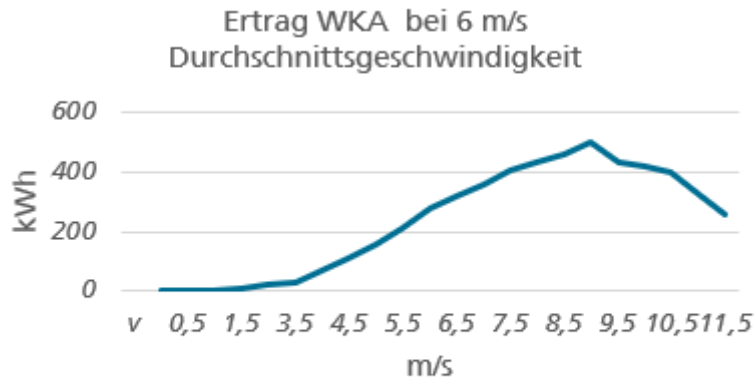
Yield WKA at 5 m/s  
average speed



— Ertrag WKA in kWh

Total: 3.597,16 kWh/a

Yield WKA at 6 m/s  
average speed



— Ertrag WKA in kWh

Total: 5.187,10 kWh/a

Links to publication of the project:

<https://www.spektrum.de/news/kleinwindkraftanlagen-ein-windrad-hinterm-gemuesebeet/1916452>

<https://www.iap.fraunhofer.de/de/Pressemitteilungen/2021/wasserstoffkraftwerk-fuer-den-garten.html>

<https://www.fraunhofer.de/content/dam/zv/de/presse-medien/2021/mai/iap-wasserstoffkraftwerk-fuer-den-garten.pdf>

<https://www.wfg-lds.de/aktuelles/news/gruener-wasserstoff-aus-dem-eigenen-garten/>

[https://www.lr-online.de/lausitz/luckau/energiewende-mini-windkraftanlage-fuer-eigenheime\\_made-in-luckau\\_-57297855.html](https://www.lr-online.de/lausitz/luckau/energiewende-mini-windkraftanlage-fuer-eigenheime_made-in-luckau_-57297855.html)

<https://www.si-shk.de/blog/kraftwerk-fuer-den-garten-111093/>

<https://www.haute-innovation.com/magazin/energie/wasserstoffkraftwerk/>

<https://edison.media/energie/ein-mini-kraftwerk-fuer-den-garten/25217288/>

<https://tenor.bethmannbank.de/das-mini-wasserstoff-kraftwerk-im-garten/>


We are currently setting up production for the small wind turbines in Brandenburg. For more information on availability and details of the product, please contact us at [info@phoxi-energy.com](mailto:info@phoxi-energy.com)

We will get back to you promptly for a personal exchange.

Thank you very much,



Raúl Comesaña Macias  
Managing Director



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